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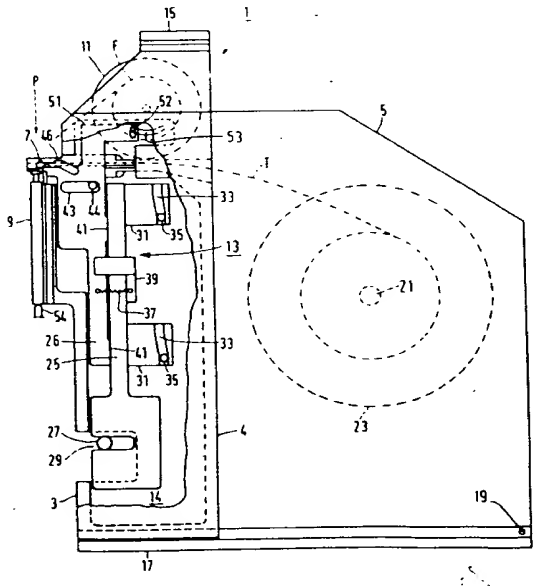
(54) **Device for feeding electronic components packed in tape to a pick-up position.**

(57) A device for feeding electronic components packed in tape to a pick-up portion, comprising a housing with a holder for a supply reel, a feeding and locking mechanism, a lifting mechanism and a wind-up mechanism, which mechanisms in combination with the housing form a cassette unit. By exchange of a number of exchangeable parts, the cassette unit can be adapted in a comparatively simple manner for processing tapes and components having different dimensions.



EP 0 146 154 A1

"Device for feeding electronic components packed in tape to a pick-up position.

The invention relates to a device for feeding electronic components packed in tape to a pick-up position, comprising a holder for a supply reel, a feeding and locking mechanism, a lifting mechanism and a wind-up mechanism.

Devices known hitherto for feeding electronic components packed in tape are composed of separate individual and product-dependent mechanical elements which are mounted sometimes in combination but generally separately, on the frame of a component mounting device to which the components are supplied and which serves for further processing and placement of the components. Such known devices are not flexible because upon readjustment to handle a tape having different dimensions and carrying other types of component, most of the separate mechanical elements have to be exchanged. The range of chip-type components which do not have the conventional comparatively long connection wires and which are suitable to be surface mounted on imperforate substrates is gradually widening; the variety in dimensions of the tapes in which the components are packed is also increasing. This variety of components and tapes results in a number of specimens of different dimensions of each mechanical element having to be stocked. The exchange of the mechanical elements has to take place on the component mounting device itself. Finally, each mechanical element has to be separately adjusted and positioned, which is not conductive to the overall precision of the device and to the reproducibility in processing and placement of the components.

The invention has for its object to provide a device for feeding electronic components packed in tape, which device feeds the components with a high degree of precision and reproducibility to the pick-up position,

has compact dimensions, comprises a comparatively small number of mechanical elements and can be exchanged rapidly and in a simple manner.

For this purpose the device according to the invention is characterized by a housing which serves as a common support forthe reel holder, the feeding and locking mechanism, the ejection mechanism and the wind-up mechanism and in combination therewith forms an exchangeable cassette unit.

By the measures according to the invention, a very compact unit is obtained in whih all the required mechanical elements are combined with a high degree of precision to form a cassette. This cassette has the same advantages as cassettes in general, namely, standard dimensions, a composition of standard components and a capability of rapid and simple exchange. For the further processing of the components to be supplied, the cassette as a whole need only be coupled to another device, for example, a component mounting device, and be positioned with respect to this device. The device according to the invention is also suitable for adaptation to and the processing of smaller series of different components and tapes.

It should be noted that the European Patent Application EP 0 071 302 A1 discloses a device for feeding electronic components packed in tape. In this known device, the reel holder on the one hand and the feeding and locking mechanism on the other hand constitute separate units and the winding unit is mounted on the reel holder. Moreover, all the units are of multi-part construction. This device is particularly suitable for processing very large series of the same sequence of electronic component. The arrangement and the adaptation for processing another sequence of components are time-consuming.

A preferred embodiment of the device according to the invention is characterized in that the housing is provided with a support for a supply reel, with a transport

channel constituting a guide for a tape carrying components to be supplied, with a bearing for a wind-up reel, with a sliding mechanism, with a feeding pin, with a locking pin and with a lifting pin. The housing serves as a support for a number of exchangeable mechanical elements which are specific to a given product, such as a transport channel, lifting pin, wind-up reel and the like, and is provided to this end with a number of positioning faces. Due to the fact that the housing can be constructed as a standard element, the cost is comparatively low in spite of the required very high accuracy to shape and size. The housing itself is suitable for components and tapes of all the dimensions and shapes that already exist and which are still to be expected. By exchange of one or more of the exchangeable product-dependent mechanical elements, the device can be adapted rapidly and in a simple manner to components and tapes of different shapes and dimensions. Due to the fact that all the exchangeable mechanical elements are positioned accurately with respect to the housing, a very accurate overall positioning is obtained for the further processing of the components fed and supplied solely by mounting and positioning the cassette unit with respect to a component mounting device.

In another preferred embodiment of the device according to the invention, the sliding mechanism comprises a feeding slide and a driving slide which are positively force-coupled to each other in the feeding direction and are frictionally force-coupled to each other in a direction transverse to the feeding direction, the feeding pin being secured on the feeding slide and the locking pin being secured on a lever which is pivotable about a fixed axis and which co-operates with the feeding slide, while the driving slide is movable in the feeding direction by means of a cam system consisting of cam tracks and cam followers.

By these measures the number of essential mechanical elements of the device is limited, as a result of which tolerances and clearances are also limited and the

reproducibility is influenced positively. Due to the sliding mechanism, a very compact construction of the device with extremely small dimensions is obtained. The small width of the device is of great practical importance in connection with the further processing and simultaneous placement of a number of electronic components on a substrate. For this purpose, several of the cassette units according to the invention, for example, ten to twenty, depending upon the dimensions of the components and tapes to be processed, have to be arranged within a given area. It has been found in practice that by the above measures a cassette unit can be obtained whose overall maximum width is only 8 mm larger than the width of the tapes to be processed having standard widths of 8, 12, 16, 24 and 32 mm.

In a further preferred embodiment of the device according to the invention, the cam tracks are provided on exchangeable cam plates. The feeding movement of the feeding slide is derived from the movement of the driving slide by the cam system. The feeding stroke of the feeding slide and hence of the feeding pin depends upon the profile of the cam tracks. Since the cam plates with the cam tracks are exchangeable, the device can be rearranged and adapted rapidly and efficiently to a tape in which the electronic components are spaced at a different pitch and for whose processing a different feeding stroke is required. In the known standard tapes, the components are spaced at a pitch equal to a multiple of 4 mm. The cam plates can be mounted on the driving slide and the cam followers on the housing or vice versa.

Another preferred embodiment of the device according to the invention is characterized in that the feeding slide is provided with guides co-operating with the driving slide, the driving slide and the guides being frictionally pressed against each other by a spring. In this way, a simple friction coupling between the driving slide and the feeding slide is obtained. The positive

feeding movement of the feeding slide is derived from the movement of the driving slide by the said cam system and by said friction coupling. This coupling between the slides acts as a kind of slip coupling which limits the maximum force that can be transmitted so that disturbances due to jamming or to damage of the device or of the tape carrying the components are avoided. By a suitable choice of the spring, the maximum frictional force available can be influenced.

The driving slide can be driven positively both in the forward stroke and in the backward stroke of its movement in the feeding direction, for example by a cam, a lever and the like. In an alternative preferred embodiment of the device according to the invention, the driving slide is displaced against the action of the spring during the forward stroke in the feeding direction, the backward stroke taking place under the action of the spring, which simultaneously presses the cam tracks and the cam followers against each other.

The device according to the invention becomes even more compact and complete in a further preferred embodiment in which the sliding mechanism is provided with an abutment arm which co-operates with a driving element, such as a driving pin or a driving roller, of the wind-up mechanism to drive this mechanism. The abutment arm can be secured either on the driving slide or on the feeding slide.

In a still further preferred embodiment of the device according to the invention, the wind-up mechanism comprises a driving disk on which the drivingelement is secured, a friction coupling, a driven disk, a reel rim, a detachable reel flange and a cover plate connected to the housing, a feeding pawl being provided on the driven disk and a locking pawl being provided on the cover plate, which pawls co-operate with ratchet teeth on the inner periphery of the reel rim. By these measures a very compact construction of the wind-up mechanism is obtained.

This mechanism comprises only a single exchangeable part, namely, the detachable reel flange. For handling another type of tape having a different width dimension, only the reel flange need be exchanged.

In a further preferred embodiment of the device according to the invention in which the reel holder is pivotally mounted on the housing, the reel holder can be swung out and an empty reel replaced with a fresh full reel while the device is in operation and the last part of the tape from the empty reel is being processed. When the beginning of the fresh tape is connected to the end of the preceding tape, for example, by means of adhesive tape, the fresh tape can be threaded in without it being necessary to stop the device.

The invention will be described more fully with reference to the drawings. In the drawing :

Fig. 1 shows an embodiment of the device according to the invention in side elevation with part of the reel holder broken away,

Fig. 2 is a sectional view on the line II-II in Fig. 1,

Fig. 3 is a side elevation of the device looking in the direction of the arrow III in Fig. 2 and with part of the housing broken away,

Fig. 4 shows on an enlarged scale a part of a the device as viewed in Fig. 3,

Fig. 5 shows on an enlarged scale a part of the device as viewed in Fig. 1,

Fig. 6 is an axial sectional view of the wind-up mechanism drawn to an enlarged scale,

Figures 7a, 7b, 7c and 7d show the feeding slide diagrammatically in successive positions, and

Fig. 8 is a slide elevation of another embodiment of the device according to the invention with part of the supply reel broken away.

The device 1 shown in Figures 1 to 3 comprises a housing 3 which acts as a basic element and as a

support and on which are secured a reel holder 5, a guide 7 for a tape T carrying electronic components, a lifting mechanism 9 and a wind-up mechanism 11; a feeding and locking mechanism in the form of a sliding mechanism 13 is slidably journalled in a cavity 14 in the housing 3. These mechanisms in combination with the housing form a cassette unit. The device serves for feeding electronic components packed in the tape T to a pick-up position P. The device 1 is coupled for this purpose to another device, such as a component mounting device, which serves for further processing the components supplied to the pick-up position P. The two devices are positioned with respect to each other so that the centre line of the lifting mechanism 9 coincides with a centre line of a pick-up not shown, which forms part of the component mounting device. The housing 3 is provided on the upper side and on the lower side with reference surfaces on which are provided bars 15 and 17 with profiled cross-sections, which serve for positioning the cassette unit with respect to the said component mounting device. The reel holder 5 is pivotally arranged on a pivot pin 19, which is secured to the bar 17. Reference numeral 21 denotes a reel shaft which is secured on the reel holder 5 and on which a reel 23 can be journalled. The sliding mechanism 13 mainly consists of a driving slide 25 and a feeding slide 26. The driving slide 25 is displaceable in a vertical direction and is driven with a reciprocating movement by means of a lever or a drive roller 27 which co-operates qith a slot 29 in the slide. The driving slide 25 is provided with two identical detachable cam plates 31 each provided with a cam track 33 co-operating with fixed cam rollers 35 which actsas cam followers and which are secured on the inner wall of the housing 3. By means of a spring 37 acting through a clamping block 39, the driving slide 25 is pressed against two guides 41 on the feeding slide 26. The vertical reciprocating driving movement of the driving slide 25 is converted by means of the

cam system consisting of the exchangeable cam plates 31 and cam rollers 35 into a horizontal reciprocating feeding movement of the driving slide 25 and with it the feeding slide 26, which also performs a short reciprocating movement in a vertical direction. This vertical stroke of the feeding slide 26 is limited by a slot 43 in the feeding slide co-operating with a fixed cam roller 44 mounted on the wall of the housing 3. Reference numeral 46 designates a locking lever. The operation of the slides will be described more fully hereinafter.

The guide 7 is provided with a transport channel 8 for feeding and guiding the tape T. The feeding slide 26 has secured on it an abutment arm 51 which co-operates with a driving roller 52 of the wind-up mechanism 11, which serves for pulling offand winding up a cover foil F which closes the cavities in the tape T accommodating the electronic components. The lifting mechanism 9 is also mounted on a reference surface of the housing 3. The lifting mechanism 9 is driven by means of a driving rod 54. The driving rod 54and the driving roller 27 are preferably coupled to the same drive; at any rate, the driving rod 54 and the driving roller are driven synchroneously. The housing 3 is closed on one side by a plate-shaped cover 4.

Fig. 4 shows on an enlarged scale the part of the device comprising the lifting mechanism 9, which mainly consists of a cylindrical housing 55 in which a piston 56 is displaceable, which piston is connected to a driving pin 57 and is coupled to lifting pin 58. Reference numeral 59 designates a return spring. The housing 55 is provided with a mounting part 60 by means of which the lifting mechanism 9 is secured on the housing 3 and is positioned with respect to the housing so that the centre line of the lifting pin 58 passes through the centre of one of a succession of openings which are provided in the bottom of the tape T at the centres of the cavities. The tape T is aligned in this position in a manner to be described more

fully hereinafter by a locking pin 62 which is secured on the locking lever 46. The lever 56 is pivotally journalled on a pivot shaft 63 which is fixedly connected to the housing. Further, the locking lever 46 is provided with a cam roller 64 which co-operates with a groove 65 in the feeding slide 26. Reference numeral 67 denotes a feeding pin which is secured on the feeding slide 26.

Fig. 5 further shows a guide element 69 which serves to guide the cover foil F to the wind-up mechanism 11.

Fig. 6 shows on an enlarged scale a sectional view of the wind-up mechanism 11 which is mounted in a cavity 12 of the housing 3. The aforementioned driving roller 52, which is driven with a reciprocating movement by the abutment arm 51 on the feeding slide 26, is connected via an arcuate opening 53 in the wall of housing 3 to a driving disk 71. By means of friction plates 72, the driving disk 71 cooperates with a driven wheel 73 which is provided with a feeding pawl 74 which co-operates with ratchet teeth 75 on the inner periphery of a reel rim 76. These rotating parts of the wind-up mechanism are covered by a non-rotating cover plate 77, which is fixedly connected to the housing 3 and which is provided with a locking pawl 78, which also co-operates with the ratchet teeth 75. A reel flange 79 isconnected by means of a bayonet joint 80 to the reel rim 76 and constitutes the exchangeable part of the reel and of the wind-up mechanism. Via the driving roller 52 the driving disk 71 is driven with an oscillating movement and the disk 71 in turn drives the wheel 73 via the friction plates 72. By means of the feeding pawl 74 and the ratchet teeth 75, the reel rim 76 is rotated in a stepwise manner and after each step the rim 76 is held in the new position by the locking pawl 78. By this stepwise rotation of the reel rim 76, the covering foil F is pulled off the tape T, is guided via the guide element 69 to the reel 76, 79 and is wound up on this reel. The maximum torque to be transmitted via the

friction plates 72 to the reel rim is adjusted by means of an adjustment nut 70 in such a manner that with an increasing diameter of the foil on the reel the friction coupling formed by the plates 72 begins to slip in order to avoid the cover foil F being torn.

Figures 7a, 7b, 7c and 7d show the positions of the feeding pin 67 and the locking pin 62 at successive stages of acycle. For the sake of clarity, the tape T is shown diagrammatically in plan view with cavities A, B, C and D and with sprocket holes a, b, c, d and e , which are spaced at a pitch R, in practice 4 mm and which are not covered by foil F. The cavities in the tape T are each provided with a central opening O which, when the respective cavity is in the pick-up position, is located in line with the accurately positioned lifting pin 58. The distance between the centres of successive components corresponds to the pitch S between two successive openings O which is a multiple of pitch R. The feeding stroke to be performed by the feeding slide is equal to the pitch S. Because the pivot shaft 63 of the locking lever 46 is fixedly secured to the housing, the pivot shaft 63, the locking pin 62 and the ejection pin 58 are accurately positioned with respect to each other. The centre line H-H of the lifting pin 58, is taken as a reference.

Fig. 7a shows the situation after a feeding stroke has been performed, the relevant component E has been removed fromthe cavity A and the backward stroke of the feeding slide 26 has started. The tape T is held in position with respect to the lifting pin 58 as a result of the locking pin 62 being brought into engagement with the sprocket hole a by rotary movement of the lever 46 about the pivot shaft 63. The rotary movement of the lever 46 is effected by cooperation between the roller 64 on the lever 46 and the groove 65 in the feeding slide 26 during a small initial downward movement of the feeding slide. The feeding slide 26 is taken along with the driven slide 25 by frictional force in the downward movement of the driving

slide until the upper wall of the slot 43 in the feeding slide engages the fixed cam roller 44. In the situation shown, the cavities B, C and D are still closed by the cover foil F,

Fig. 7b shows the situation in which the feeding slide 26 performs a backward stroke in a horizontal direction after the short downward stroke shown in Fig. 7a and as a result of the further downward movement of the driving slide 25. The tape T remains held in the same position with the locking pin 62 still in engagement with the same sprocket hole a.

Fig. 7c shows the situation at the beginning of the driving stroke by the driving slide, which by friction takes the feeding slide 26 with it in a short upward stroke until the cam roller 44 comes into engagement with the lower wall of the slot 43. As a result of this movement of the feeding slide 26 the lever 46 rotates counterclockwise about the pivot shaft 63 and the locking pin 62 is disengaged from the sprocket hole a; however, in the meantime the feeding pin 67 has come into engagement with the sprocket hole e so that the tape T remains under control.

Fig. 7d finally shows the situation towards the end of the feeding stroke. The tape T is transported by the feeding pin 67 over a feeding distance equal to the pitch S between two successive openings O in the embodiment shown equal to three times the pitch R between the sprocket holes. The cavity B is now located with the centre of its opening O in line with the centre line H-H of the lifting pin 58. In thissituation the tape T is positioned by the feeding pin 67. The feeding slide 26 has reached the point of reversal and stops for a short time. The locking lever 46 also stops. Also during the feeding stroke the cover foil F is pulled off the tape T to uncover the cavity B so that the component E located therein is accessible. In this situation the component is removed from the cavity.

As soon as the feeding slide 26, taken along by

the driving slide, starts again the short downward stroke, the locking lever 46 is rotated clockwise so that the locking pin 62 comes into engagement with the sprocket hole d, while the feeding pin 67 is disengaged from the sprocket hole e. The situation shown in Fig. 7a is reached again, in which the tape T is held in position by the locking pin 62.

The various components are constructed, proportioned, mutually adapted and synchronized with each other in such a manner that the tape T always remains under control, that is to say that either the locking pin 62 or the feeding pin 67 is in engagement with one of the sprocket holes. For these reasons, the two pins never come into engagement with the same sprocket hole. During the transfer of the indexing of the tape T from one pin to the other, overlap always occurs, the two pins then being simultaneously in engagement with a sprocket hole. The movements of the mechanical elements are adjusted in such a manner that no transport of the tape takes place when a cavity with a component in it is open.

An alternative embodiment of the device according to the invention is shown in Fig. 8, in which elements corresponding to those of the first embodiment are designated by the same reference numerals. The device 81 shown comprises also a housing 3 provided with a guide 7 for feeding a tape carrying electronic components from a reel 23 journalled on a reel shaft 21 in the housing. There are further secured on the housing 3 a lifting mechanism 9, a wind-up mechanism 11 and a lever 46 with a locking pin 62. The housing accommodates a sliding mechanism 13 consisting of a driving slide 25 and a feeding slide 26 with a feeding pin 67. The driving slide 25 is provided with two identical cam plates 31 each co-operating via a cam track 82 with a fixed cam roller 35. In this embodiment an abutment arm 51 cooperating with a driving roller 52 for driving the wind-up mechanism 11 is secured on the driving slide 25. The feeding slide is provided with a slot 43

cooperating with a cam roller 44 on the housing for limiting the vertical stroke of the feeding slide. The feeding slide is again provided with two guides 41 for the driving slide and carries a guide roller 83. Three further guide rollers 85 are journalled in the housing 3. An elongate coil spring 87, one end of which is connected to the housing 3 via a pin 88 and the other end of which is secured to a pin 89 onthe abutment arm 51, passes round the guide rollers 83 and 85 and exerts a force on tne feeding slide 26 such that the guides 41 are pressed against the driving slide and the cam tracks 82 on the driving slide are in turn pressed against the cam rollers 35. In this embodiment the driving slide 25 is driven only in the forward upward stroke, against the action of the spring 87; the backward stroke of the driving slide 25 takes place under the action of the spring 87. In the embodiment shown, the wind-up mechanism 11 is driven by the abutment arm 51 upon the backward stroke of the driving slide 25, against the action of a spring not shown.

Product tapes which have the same width but in which the electronic components are spaced at different pitches require different feeding strokes. A minimum readjustment is required for such an adaptation of the cassette unit according to the invention. Only the cam plates 31 have to be exchanged for cam plates which convert the driving stroke of the driving slide 25 into the desired feeding stroke of the feeding slide 26. The sliding mechanism 13 is readily accessible by simply removing the cover 4. If the cam plates 31 are integral with the driving slide 25, the whole driving slide is exchanged.

A further readjustment is required for the adaptation of the cassette unit to product tapes with different tape widths: the guiding bars 15 and 17, the lifting mechanism 9 as a whole, the guide 7 for the tape and the exchangeable reel flange 79 of the wind-up mechanism 11 have to be exchanged.

As already mentioned, a number of standard tapes with standard dimensions have been developed for packing electronic chip-type components. In these tapes the pitch of the sprocket holes is 4 mm the distance between successive components and hence the required feeding stroke is equal to a multiple of 4 mm and the widths of the packing tape increase from 8 mm through a sequence of 12, 16 and 24 mm to 32 mm. Taking these standard dimensions into account, the stock of mechanical elements can remain limited, especially if extreme dimensions which are not commonly used are ignored, at least by the user.

The flexibility of the cassette unit according to the invention has been clearly demonstrated. An element which intentionally is not integrated in the cassette is a cutting device for cutting the empty tape into pieces. Since such a cutting device does not require an accurate arrangement and positioning, it is not necessary to combine the cutting device with the precision cassette according to the invention.

In the embodiment described the components are supplied in a tape, the cavities of which each are provided with a central opening in the bottom. Since the lifting pin 58 consequently does not have to pierce the bottom of the cavities, the free end of the pin is blunt and is provided with an end face. However, the components may also be supplied in a tape which does not have openings in the bottoms of the cavities, in which case the lifting pin 58 has to pierce the bottoms of the cavities and is therefore pointed at the free end.

The different parts of the cassette unit may be made in any convenient material, such as metal, especially light metal alloy or synthetic resin; the parts may be manufactured by the most economic proces, for example, injection-moulding.

1. A device for feeding electronic components packed in tape to a pick-up position, comprising a holder for a supply reel, a feeding and locking mechanism, a lifting mechanism and a wind-up mechanism, characterized by a housing which serves as a common support for the reel holder, the feeding and locking mechanism, the lifting mechanism and the wind-up mechanism and in combination therewith forms an exchangeable cassette unit.

2. A device as claimed in Claim 1, characterized in that the housing is provided with a support for a supply reel, with a transport channel constituting a guide for a tape carrying components to be supplied, with a bearing for a wind-up reel, with a sliding mechanism, with a feeding pin, with a locking pin and with a lifting pin.

3. A device as claimed in Claim 2, characterized in that the sliding mechanism comprises a feeding slide and a driving slide which are positively form-coupled to each other in the feeding direction and are frictionally force-coupled to each other in a direction transverse to the feeding direction, the feeding pin being secured on the feeding slide and the locking pin being secured on a lever which is pivotable about a fixed axis and which co-operates with the feeding slide, while the driving slide is movable in the feeding direction by means of a cam system consisting of cam tracks and cam followers.

4. A device as claimed in Claim 3, characterized in that the cam tracks are provided on exchangeable cam plates.

5. A device as claimed in Claim 3 or 4, characterized in that the feeding slide is provided with guides co-operating with the driving slide, the driving slide and the guides being frictionally pressed against each other by a spring.

6. A device as claimed in Claim 5, characterized in that the driving slide is displaced against the action of the spring during the forward stroke in the feeding direction, the backward stroke taking place under the action of the spring, which simultaneously presses the cam tracks and the cam followers against each other.

7. A device as claimed in any of Claims 2 to 6, characterized in that the sliding mechanism is provided with an abutment arm which co-operates with a driving element of the wind-up mechanism to drive this mechanism.

8. A device as claimed in Claim 7, characterized in that the wind-up mechanism comprises a driving disk on which the driving element is secured, a friction coupling, a driven disk, a reel rim, a detachable reel flange and a cover plate connected to the housing, a feeding pawl being provided on the driven disk and a locking pawl being provided on the cover plate, which pawls co-operate with ratchet teeth on the inner periphery of the reel rim.

9. A device as claimed in any one of Claims 1 to 8, characterized in that the reel holder is pivotally mounted on the housing.

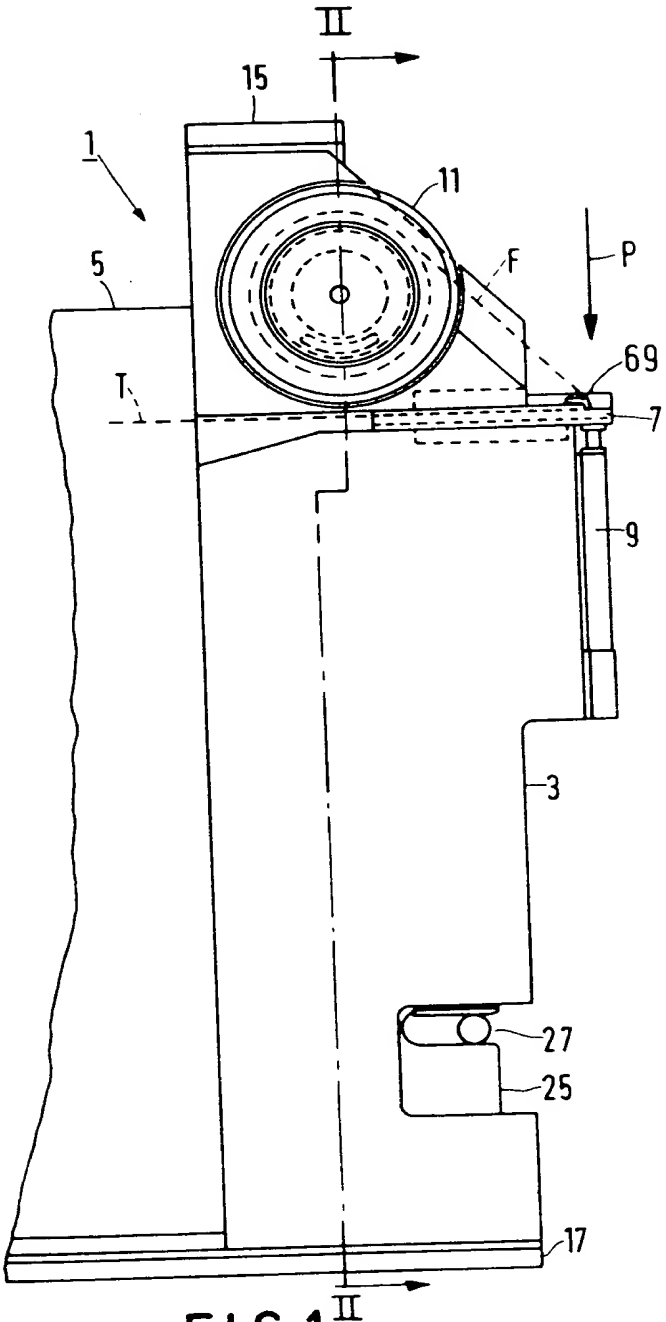


FIG.1

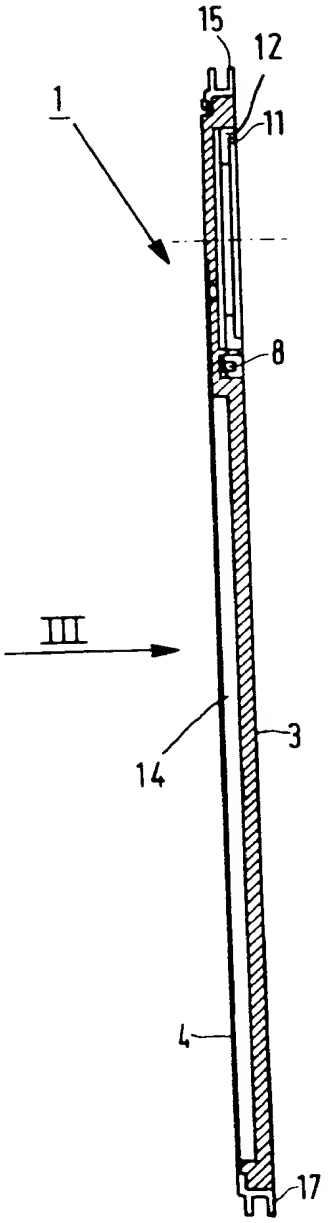


FIG.2

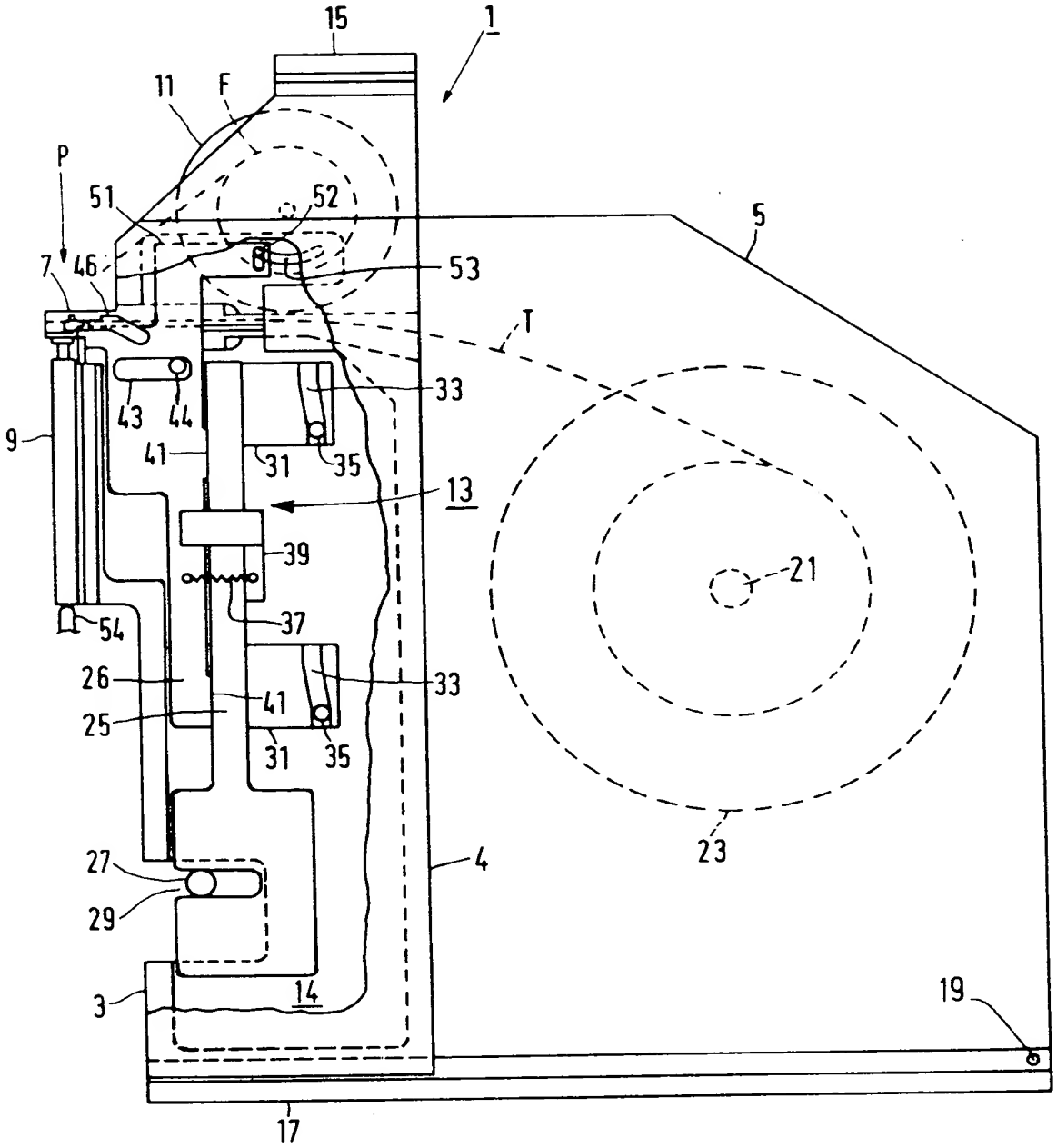

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FIG.3

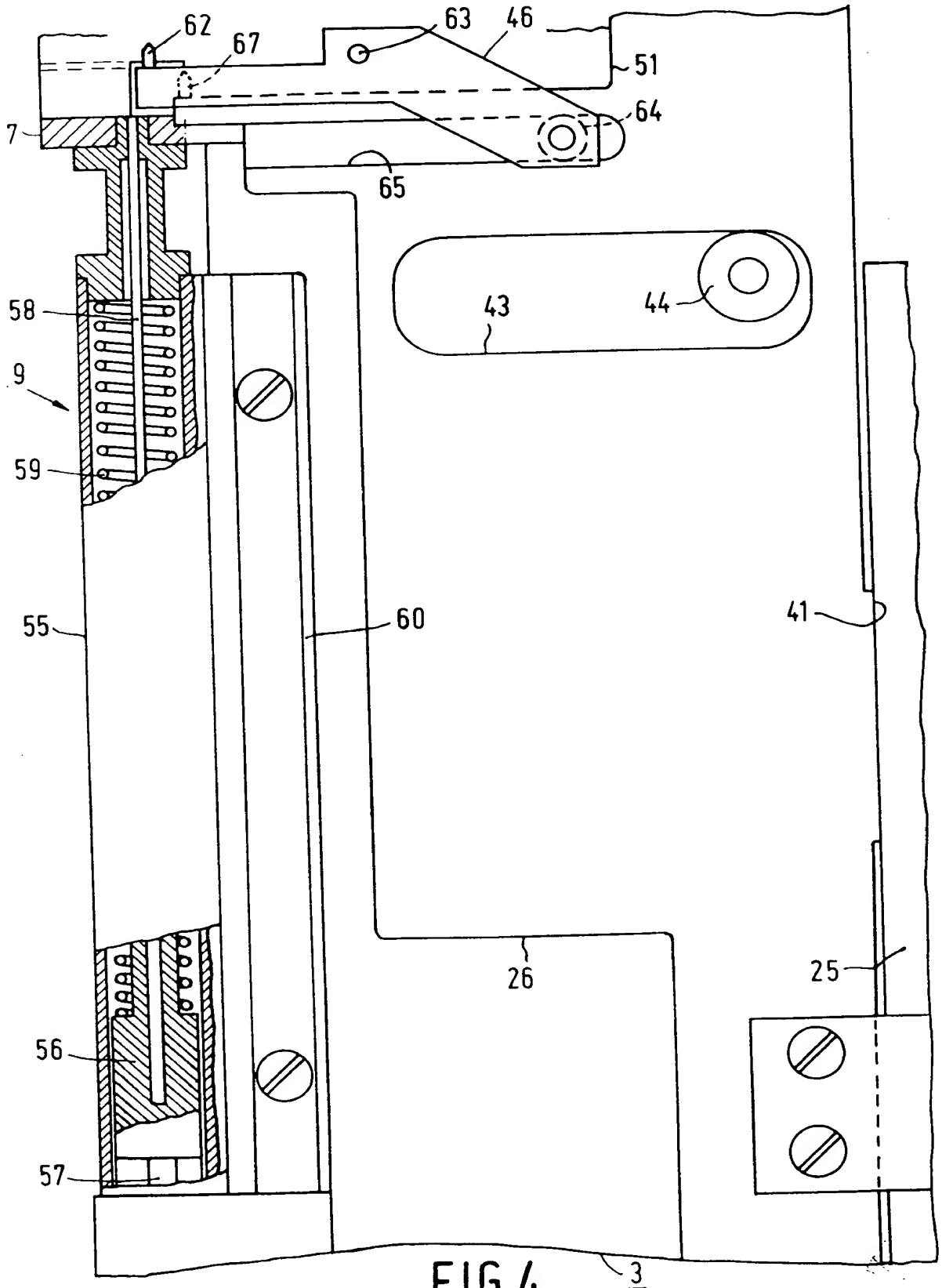


FIG.4

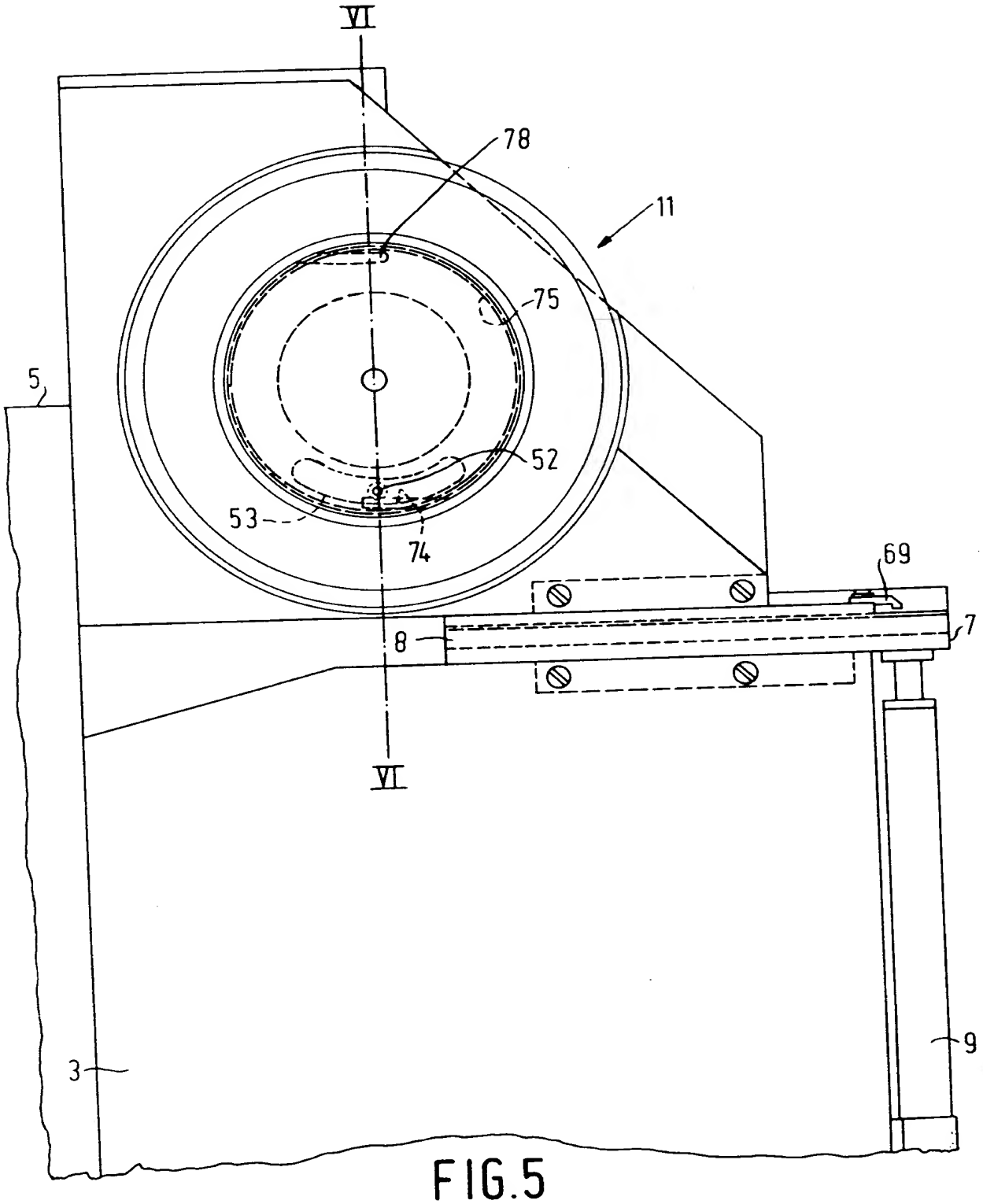


FIG.5

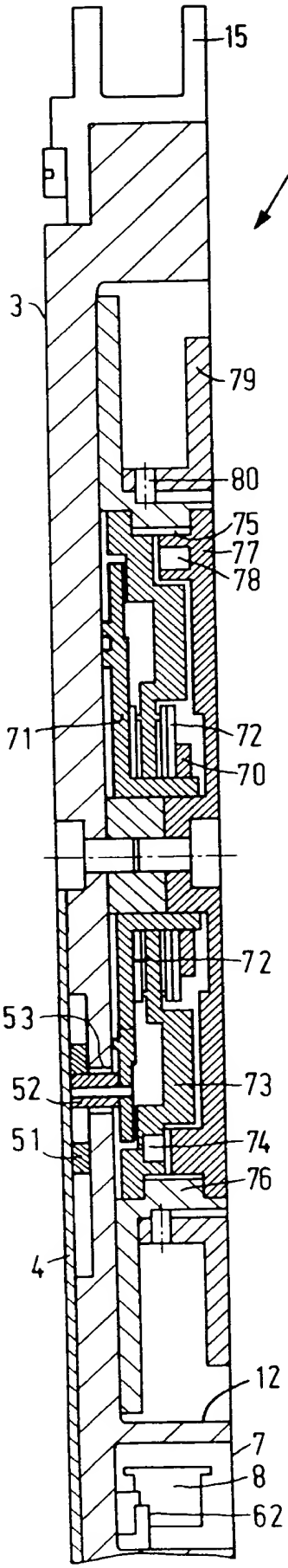
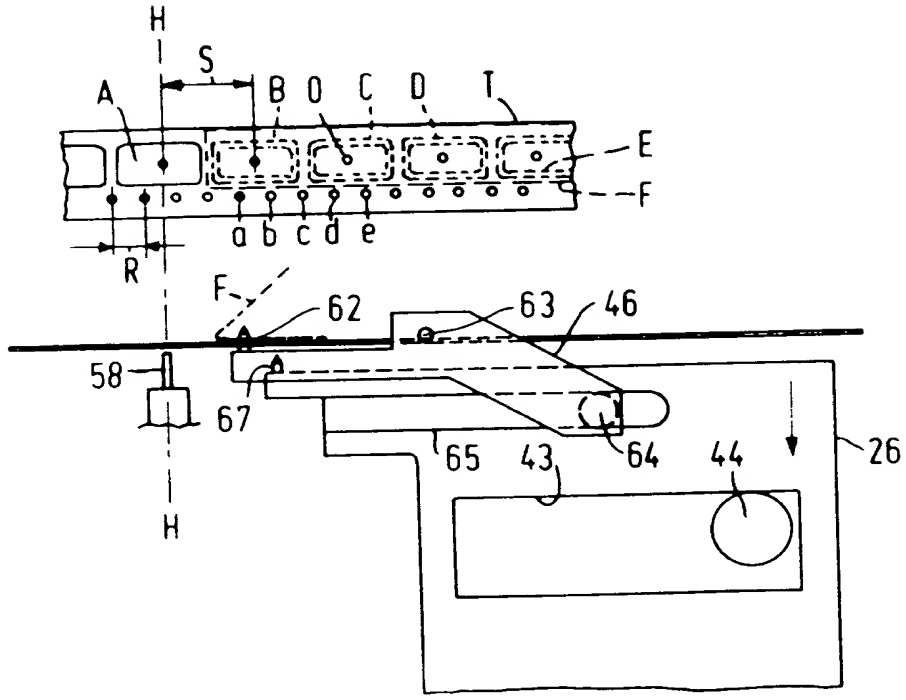


FIG.6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H

FIG.7a

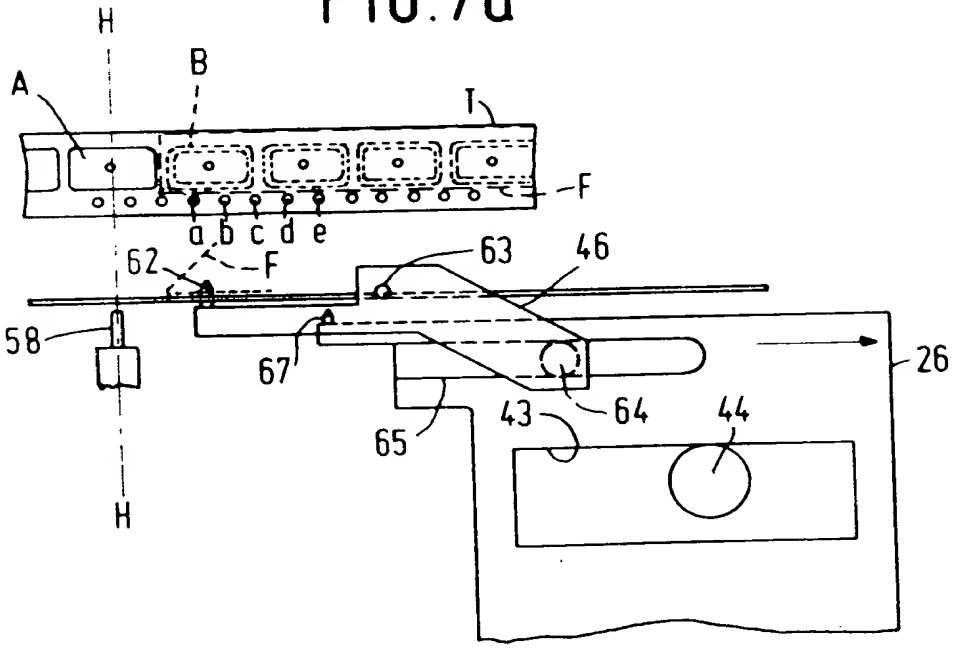
H
B
A
T
F
a b c d e
62
F
63
46
58
67
65
43
64
44
26
H

FIG.7b

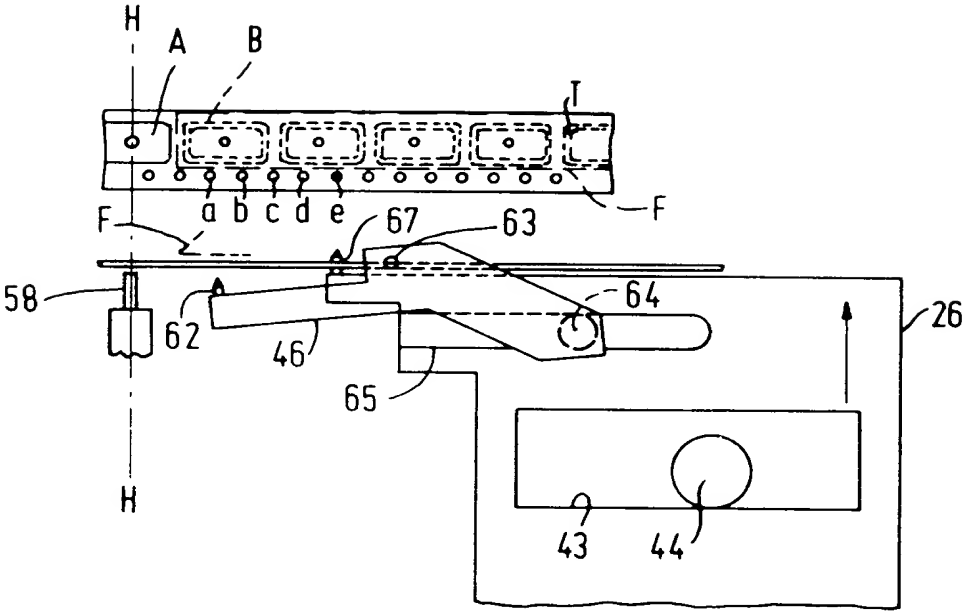
H
A
B
I
a b c d e
F
F
67
63
58
62
64
46
65
26
H
43
44

FIG.7c

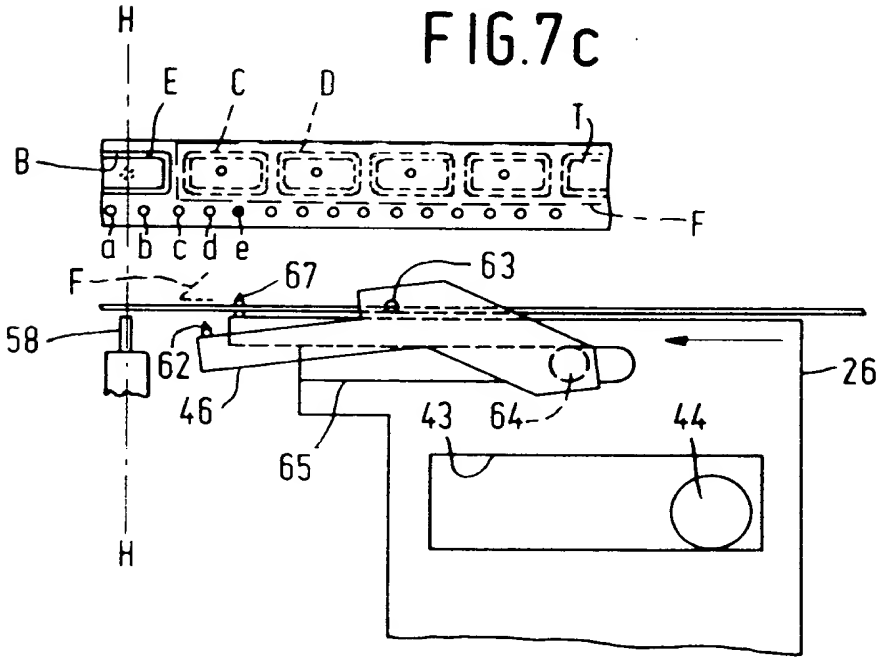
H
E
C
D
I
B
F
a b c d e
F
67
63
58
62
26
46
43
64
44
65
H

FIG.7d

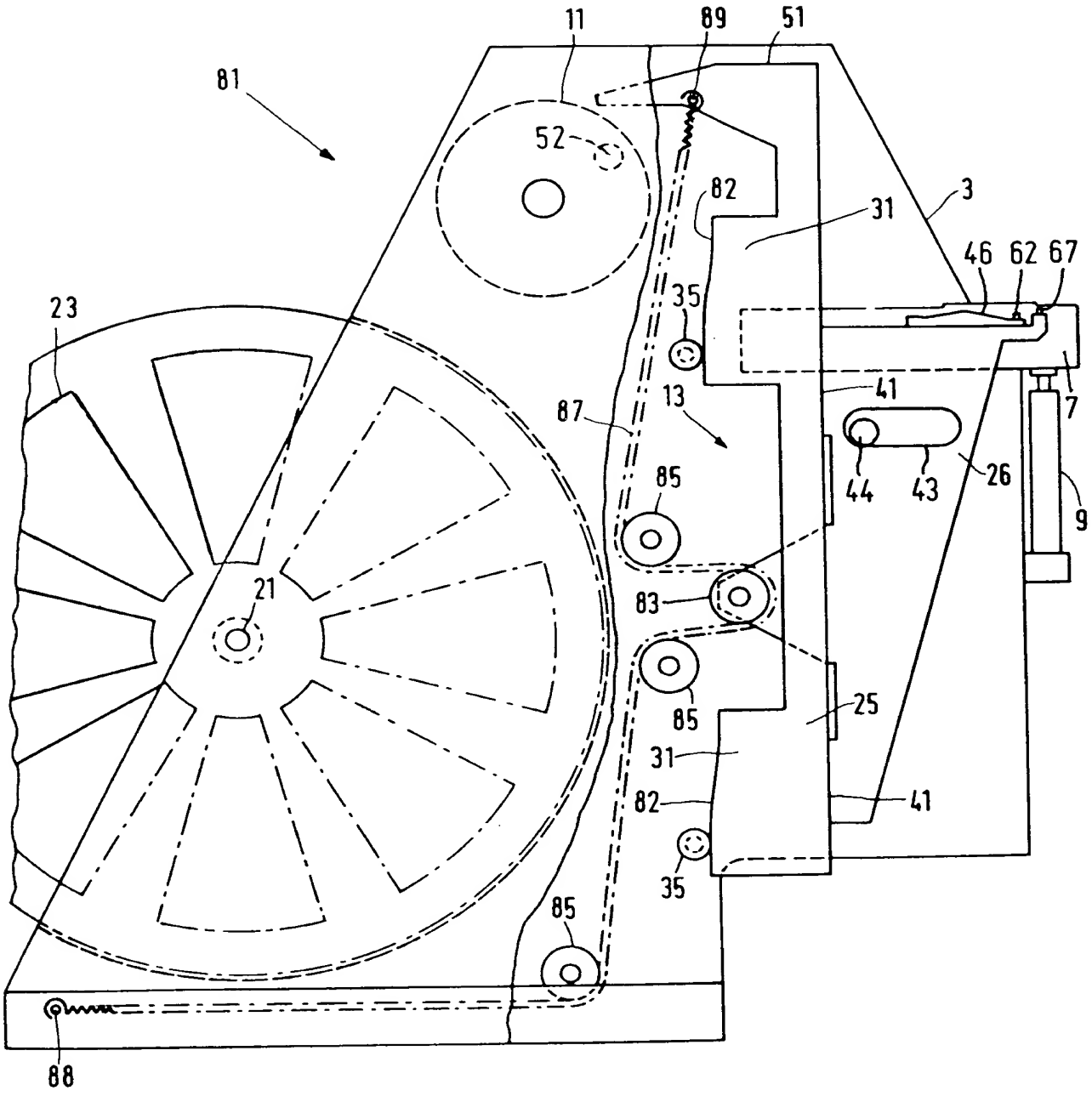
11
89
51
81
52
82
31
3
46
62
67
23
35
41
13
87
7
85
44
43
26
9
21
83
85
25
31
82
41
35
85
88

FIG.8